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LONG-TERM FOLLOW-UP OF BEHAVIORAL TREATMENT FOR OBESITY: PATTERNS OF WEIGHT REGAIN AMONG MEN AND WOMEN

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Maintenance of weight loss continues to be a critical concern in behavioral treatment programs. Problems with the acquisition and/or application of behavioral skills are a likely contributor to relapse. However, biological models, especially the hypothesis of a body weight setpoint, are being offered increasingly as alternative explanations for maintenance failure. Within the context of these sometimes opposing viewpoints the present study describes long-term weight outcomes for 114 men and 38 women assessed annually for 4 or 5 years following completion of a 15 week behavioral weight loss program. Although significant mean weight loss was evident at long-term follow-up, a negatively accelerating pattern of weight regain was the predominant outcome. Less than 3 percent of the subjects were at or below their posttreatment weight on all follow-up visits. Consistent sex differences were found, with women having better weight loss maintenance than men. Implications and potential future directions are discussed.

Keywords: behavioral treatment, weight regain, weight loss.

Introduction

Maintenance of weight loss is problematic for the majority of obese individuals receiving treatment[1,2]. Existing follow-up data of nonsurgical weight loss treatments are characterized by virtually invariant weight regain and understanding of weight regain phenomena has proven elusive. Few studies to date have examined weight status beyond one year posttreatment, and those that have frequently involved small sample size, high loss to follow-up, outcome measures of potentially limited reliability or validity (e.g. self-reported weight) or few assessment points (see Table 1).

The present paper reports annual weight changes over 4 and 5 years for two groups of participants from controlled weight loss trials originally conducted in 1980–81[3,4]. The purpose is to provide descriptive information about the course of weight regain over time among individuals with different characteristics and to study patterns of weight loss and gain which might have important clinical or theoretical implications. The overall goal is to provide further understanding of

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the maintenance problem by focusing on repeated measures of outcome in a well-defined population.

Two general models are currently used to explain weight regain after treatment: biological models and social learning models. Biologically oriented models hypothesize an innate propensity to defend body fat stores and thus body weight. They predict a defense of overweight through adaptations in physiologic processes and conceptualize relapse as a consequence of these adaptations[5,6]. In observing posttreatment regain phenomena, biological models generally predict a return to baseline weight. Specifically, subjects' rate of regain is expected to be roughly proportional to the weight loss they experienced during treatment, followed by long-term stabilization near baseline values[7]. The number of prior weight losses and regains, and the duration and severity of overweight, might also be expected to increase the rate of regain due to an association with fat cell hyperplasia and/or dieting-induced increases in metabolic efficiency[8–11].

Social learning or skills oriented models predict a different set of relationships. The fundamental assumption is that relapse represents a failure to apply behavioral skills. Since skills acquisition and application need not be related to the degree of initial weight loss and are apt to be reflected in larger losses, initial losses will most likely be positively associated with degree of maintenance. Learning models agree with biological models in predicting greater relapse among those with a history of weight management failure. Unlike the biological model, however, the presumed mechanism is behavioral or motivational deficits rather than biological processes. A behavioral model would also predict a strong temporal association between skills usage and the pattern of long-term success or failure.

Previous studies have reported conflicting results regarding these hypotheses. Some authors have found a positive relationship between weight loss during treatment and weight regain during follow-up, as expected in the biologic model[2,12], while others have found the reverse to be true[13,14]. Indeed, Graham *et al.*[14] found that subjects who failed to lose weight during treatment gained an average of nearly 7 kg in a follow-up ranging from 38 to 74 months, while subjects losing weight in treatment lost an additional 0.56 kg. In addition, when the separate and combined effects of anorectic medication and behavior therapy are examined, rate of regain is slower for subjects receiving behavior therapy and rate of regain was not associated with weight loss in behavioral treatment but appeared to be in the drug conditions[15–18].

Childhood onset obesity increases the likelihood of an increased number of fat cells[19], and if there is a biological ideal for fat cell size subjects with larger numbers of fat cells would be expected to have poorer maintenance outcomes[20]. Dubbert and Wilson[12] found that subjects overweight by age 10 showed poorer maintenance than later onset subjects at a 30-month follow-up, although age of onset was not related to loss in treatment or at earlier follow-ups. Drenick & Johnson[1] reported no effect for age of onset in terms of number of subjects maintaining a weight loss after therapeutic fasting. However, significantly more juvenile onset than adult onset subjects gained to above pretreatment levels (42 *v.* 26 percent). Bosello *et al.*[21] obtained measures of fat cell size and number, as

well as age of onset, for subjects receiving six months of treatment. Subjects were separated into three groups according to whether their weight remained stable (± 1 kg), decreased, or increased during a subsequent 6-month follow-up. Subjects who regained had become obese at a significantly younger age than subjects who maintained or increased their losses (7 years *v.* 13 and 16 years). Regainers also had smaller fat cells than the other subjects but a larger number of cells.

Behavioral investigators have attempted to link the performance of weight management skills taught in a treatment program with weight outcomes. Several studies of weight maintenance have found superior maintenance for subjects reporting greater frequency of technique application[14,22–26]. Within the area of technique application, weight monitoring has been specifically related to maintenance. Stalonas *et al.*[26] reported a correlation of −0.67 between months of daily weight charting and weight gain during a 5-year follow-up. Similarly, Stuart & Guire[22] found that subjects who have a lower criterion for excess weight showed better maintenance. Gomally & Rardin[24] reported that 75 percent of subjects who maintained a 6.8 kg weight loss as compared to 19 percent of relapsers regularly monitored body weight and/or eating behavior. Daily weighing and overall number of techniques used during follow-up were associated with greater net weight loss at 1- and 2-year follow-ups of a study of middle-aged men[25].

In conclusion, evidence exists for the influence of both behavior and physiology on long-term weight regulation. Both types appear to be relevant to outcome, and the two may operate in an interactive or synergistic manner. It is hoped that the data presented here will contribute to an additional understanding of these interactions.

Methods

Subjects and measures

Subjects in the present study were participants in one of two controlled weight loss trials (study 1: Jeffery *et al.*[3]; study 2: Jeffery *et al.*[4]). Both studies employed a 15-week behaviorally oriented program including diet and exercise instruction, behavioral skills training, cognitive behavior modification, and relapse prevention training. A distinguishing aspect of the two programs was the use of financial contracts for weight loss. Subjects were assessed before and after treatment and at 1-year intervals thereafter. This report covers 5 years of follow-up for study 1 and 4 years for study 2.

Extensive efforts were made to obtain measured rather than self-reported weights at all follow-ups. Overall, 92.8 percent of the weight data was obtained via direct measurement. Self-reported weight data were obtained for persons unable or unwilling to visit the clinic. These are used in the analyses below, with 5 lb added to each self-reported weight to adjust for an underreporting bias[27–30]. All available data are presented for describing the overall results. In the analyses of patterns of weight loss, however, data were used through 4 years only and only for those subjects providing weight information at each assessment. A total of 152 subjects out of a possible 200 provided complete data (76 percent): 80 of the 89 men in the first study; 34 of the 55 men and 38 of the 60 women in the second study.

In addition to weight, variables measured at pretreatment included age of onset of obesity and prior participation in a formal weight loss program (e.g. Weight Watchers, Tops). Follow-up assessment included reported use of 13 weight maintenance techniques (e.g. daily weighing, self-monitoring) and six dieting methods (e.g. over the counter medication and diet books) since the

end of treatment. Because the instructions did not specify that subjects should report technique use and dieting efforts for only the most recent year, we were not able to give subjects a score for each year. We chose as the least biased measure of technique and dieting behavior the total number of different options reported over the entire follow-up period. Possible scores ranged from 0 to 13 for techniques and 0 to 6 for dieting.

The majority of our analyses employed weight change expressed as a percent of initial body weight. This was done because percent change is a readily understandable measure which adjusts for differences in body size. Weight change as a percent of initial body weight is similar to body mass index in that weight at a particular point in time is divided by a constant and, in fact, analyses examining change over time gave similar results for both percent of initial body weight and body mass index.

In examining the effects of gender, prior program experience and other variables on outcome, we applied repeated measure analysis of variance supplemented with correlational and mean comparisons as appropriate. These analyses provided results concerning effects across the entire follow-up, as well as at specific points in time. To examine individual patterns of weight change we obtained the frequency of different outcomes of theoretical interest.

Results

Overall results and comparison with other studies

Table 1 shows baseline and follow-up weights, sample size, sex and demographic information for our two studies and, for comparison, all other outpatient behavioral studies we could locate with follow-ups of 2 years or more. We chose not to include studies with shorter follow-up due to our focus on longer term outcome and the availability of thorough reviews of shorter periods of follow–up (e.g., Brownell & Wadden[31]). Initial weight losses in our studies tended to be larger than in the other studies listed in Table 1. The large number of men in our studies is, however, unique, which along with the added incentive of the monetary contracts may explain our relatively large losses.

Most studies in Table 1 reported weight gain during follow-up, although the magnitude varied considerably. It is noteworthy that the more encouraging results are evident in studies with clinical series rather than controlled trials, high attrition rates, or long-term data based on unadjusted self-reported weights. Thus, the between-study variation may be partially due to methodology. Greater methodological rigor seems to be associated with poorer results. Overall, the long-term patterns of weight regain observed in these studies underscore the need for better understanding of relapse.

Correlates of long-term weight change

Weight change in pounds and as a percentage of baseline weight for persons providing weights at all follow-ups in our two studies are shown separtely for men and women in Table 2. Overall patterns were similar for both men and women: weight loss in treatment followed by a negatively accelerating weight relapse curve. Men lost more weight than women, both in absolute terms and as a percent of initial body weight. However, they regained weight faster after treatment, overtaking the women at about the 3-year follow-up point. Repeated measures ANOVA of changes in percent of initial body weight showed no overall effect for gender but a significant gender by time interaction ($P < 0.001$).

Table 1. *Long-term follow-ups of behavioral weight loss programs*

Present studies	*Initial n*	*% Female*	*Treatment length (weeks)*	*Initial Weight (kg/% overwt)*	*Age*	*Net weight loss (kg/n)* *Post*	*1 year*	*2 years*	*3 years*	*4 years*	*5 years*
Study A[3]	89	0	15	100.5/44.6	52.8	13.0 (89)	7.4 (86)	5.0 (88)	4.2 (85)	3.0 (81)	2.5 (83)
Study B[4]	113	51	15	94.4/50.2	47.8	10.0 (107)	5.8 (108)	3.5 (103)	4.1 (86)	2.8 (84)	
Comparison studies											
Stunkard & Penick[2]	32	75	12	? /78.0	40.0	8.0 (32)	5.6 (28)				4.4 (26)
Stalonas *et al.*[26]	44	84	12	82.3/40.2	31.5	4.9 (44)	5.0 (41)				0.7 (35)
Gotestam[32]	15	73	16	87.2/36.2	40.9	9.4 (11)	4.6 (11)		2.1 (11)		
Kirschenbaum *et al.*[42]	65	89	12	86.9/52.0	38.2	6.1 (65)	3.7 (65)				
Murphy *et al.*[27]	62	65	10	87.5/43.3	41.3	7.4 (34)	5.4 (28)	2.8 (33)		0.5	
Dubbert & Wilson[12]	62	77	19	89.5/49.0	?	7.8 (47)	6.6[b] (47)	5.8[b] (45)	(25)		
Rosenthal *et al.*[43]	43	100	16	76.5/34.2	34.5	4.3 (37)		4.0[b]	(20)		
Levitz *et al.*[23]	437[a]	75	20	97.9/ ?	40.0	8.5 (326)		6.5[b] (154)			
Adams *et al.*[41]	125[a]	86	20	93.8/60.0	44.0	5.0 (125)		8.0[b] (58)			
Graham *et al.*[14]	138[a]	77	20	97.7/70.0	46.0	4.5 (60)				3.3 (60)	
Foreyt *et al.*[13]	817[a]	77	8	87.8/ ?	42.5	4.9 (590)	5.8 (590)				4.9[c] (426)
Foreyt (personal communication, March 1986)											

[a] Clinical series.
[b] All or majority of weights were unadjusted self-reports.
[c] Percent of weights which were self-reported was not reported.

Table 2. *Means, standard deviations and ranges for weight losses and means and standard deviations for baseline and follow-up variables. n* is equal to 114 for men and 38 for women unless otherwise noted.

	Men	*Women*
Net weight loss (kg):		
Posttreatment	13.0 (5.2;−0.9,29.5)	8.6 (3.8; 1.7,17.9)[a]
1 year	7.3 (6.4;−11.9,29.1)	6.5 (6.5;−1.8,23.6
2 years	5.2 (6.6;−19.4,23.5)	4.3 (5.6;−3.7,22.4)
3 years	4.4 (6.3;−18.9,20.0)	4.5 (5.5;−4.8,21.8)
4 years	2.8 (6.3;−21.2,18.5)	4.0 (5.8;−4.3,18.6)
Pretreatment weight (kg)	101.1 (11.5)	83.1 (14.5)[a]
Pretreatment overweight (%)	41.3 (14.4)	37.6 (24.9)
Percent with prior program experience	21.0 (n = 102)	69.0 (n = 32)[a]
Age (years)	51.2 (7.7; n = 106)	47.8 (7.9; n = 35)[b]
Age of onset (years)	24.9 (13.0; n = 107)	23.9 (15.2; n = 34)
Diet methods (mean per year)	1.1 (1.1; n = 67)	1.5 (1.3; n = 33)
Techniques (mean per year)	7.0 (2.4; n = 86)	7.5 (2.4; n = 34

[a,b] Men and women different at P <0.01 and 0.05 respectively.

Men initially lost more weight (P <0.02), but women had better net losses by the fourth year (P <0.1).

Prior experience in formal weight loss programs has been a negative predictor of weight loss in several studies. A sex by prior program repeated measures ANOVA indicated a significant prior program by sex by time interaction (P <0.05). Men with prior experience had consistently poorer outcomes than other men, while women with prior experience did not differ from other women except for a smaller initial weight loss.

Weight losses by quartiles of initial loss are shown in Figs 1 and 2 for men and women, respectively. Subjects losing the most weight initially tended to maintain their superiority during follow-up. However, while the four curves were nearly parallel for men, the curves for women cross a number of times in the bottom three quartiles of loss. Sex-specific, repeated measures analyses of weight change in the quartiles indicated significant effects for quartile and time in both sexes (P <0.001) but a significant quartile by time interaction for women only (P <0.001).

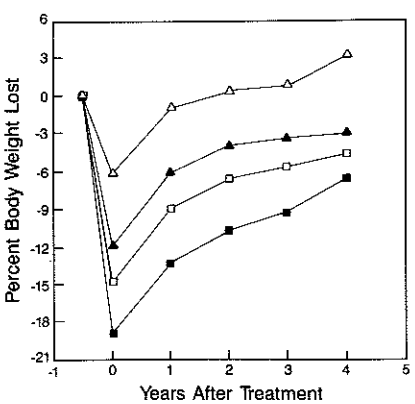

Fig. 1. *Average weight losses for men subdivided by quartile of initial weight loss.*

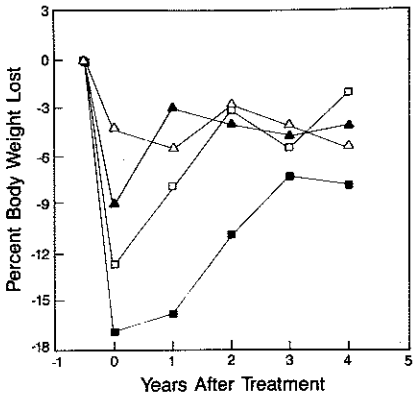

Fig. 2. *Average weight losses for women subdivided by quartile of initial weight loss.*

For women, pretreatment weight and percent overweight were negatively related to percent of initial body weight lost in treatment ($r = -0.42$, $P < 0.01$), and percent overweight was also negatively related to weight gain in the first year of follow-up ($r = -0.35$, $P < 0.05$). Heavier women lost less weight during treatment and regained less in the first year of follow-up. Weight loss during treatment was not related to long-term outcome in women. For men, initial weight and percent overweight were not related to short- or long-term outcome. However, weight loss in treatment was strongly related to net weight loss at 4 years ($r = 0.59$ $P < 0.001$).

Tables 3 and 4 show a breakdown of maintenance patterns. The categories in the left hand column refer to the percent of initial loss maintained. For each category a cumulative and cross-sectional value is provided. Cumulative values refer to the percent of subjects who had maintained at least that large a percent of their loss at the present and all previous follow-ups. Cross-sectional values refer only to status at a particular follow-up. In men (Table 3), the cumulative and cross-sectional values are very similar, indicating that recovery from relapse was unusual and monotonic regain was the predominant pattern. In women (Table 4), substantial differences between cumulative and cross-sectional values

Table 3. *Percent of men maintaining different amounts of initial loss cumulatively over time and at each follow-up.*

Percent initial loss maintained		*Year* 1	2	3	4
100+	Cumulative	7.0	2.6	0.9	0.9
	Cross-sectional	7.0	3.5	3.5	2.6
75–100	Cumulative	21.0	12.3	9.6	3.5
	Cross-sectional	21.0	13.2	10.5	3.5
50–75	Cumulative	28.9	21.0	10.5	10.5
	Cross-sectional	28.9	21.1	18.4	19.3
25–50	Cumulative	19.3	17.6	27.2	18.4
	Cross-sectional	19.3	22.8	26.3	18.4
0–25	Cumulative	13.2	25.4	22.8	29.8
	Cross-sectional	13.2	21.9	17.9	26.6
< 0	Cumulative	10.5	21.0	29.0	36.9
	Cross-sectional	10.5	17.6	23.7	29.8

Table 4. *Percent of women maintaining different amounts of initial loss cumulatively over time and at each follow-up.*

Percent initial loss maintained		*Year* 1	2	3	4
100+	Cumulative	26.3	13.2	5.3	5.3
	Cross-sectional	26.3	18.4	21.1	28.9
75–100	Cumulative	10.5	15.8	13.2	7.9
	Cross-sectional	10.5	15.8	13.2	2.6
50–75	Cumulative	23.7	7.9	10.5	13.2
	Cross-sectional	23.7	10.5	13.2	18.4
25–50	Cumulative	15.8	13.2	15.8	7.9
	Cross-sectional	15.8	13.2	21.1	13.2
0–25	Cumulative	10.5	26.3	26.3	26.3
	Cross-sectional	10.5	26.3	15.8	13.2
< 0	Cumulative	10.5	23.6	28.9	39.5
	Cross-sectional	10.5	15.8	15.8	23.7

are apparent. For example, only 5.3 percent of the women were at or below their posttreatment weight at all follow-up assessments, but 28.9 percent were at this level at the 4-year follow-up. A sizable proportion of the women showed some degree of renewed weight loss after a period of regain.

The relationships of age of onset, use of techniques, and numbers of posttreatment diets to weight outcomes were assessed in two ways. First, correlations between the three variables and weight outcomes were computed. Second, subjects obese before age 20 were compared to those who became obese after age 20, and subjects high or low according to a median split of number of techniques and diets were compared.

Correlations between weight gain in the first year of follow-up and net loss at 4 years with age of onset, number of diets, number of techniques used, and age were calculated separately by gender. Self-reported use of techniques were related to better long-term outcome for both men ($r = 0.24$, $P < 0.05$) and women ($r = 0.53$, $P < 0.01$). Number of techniques was related to first year gain for women ($r = -0.48$, $P < 0.01$) but not for men. Number of posttreatment diets did not show a relationship with outcome for either sex. Age of onset, while not related to outcome for males, was weakly related to weight gain in the first year ($r = -0.40$, $P < 0.08$) and significantly related to net weight loss ($r = -0.40$, $P < 0.05$) for women. Women who became obese at younger ages had higher net weight losses after 4 years and gained less in the first year of follow-up. For women, age was negatively related to net weight loss at 4 years ($r = -0.36$, $P < 0.05$). Further analysis indicated that in women age and age of onset were significantly correlated ($r = 0.54$, $P < 0.01$), and therefore correlations of age and onset adjusted for each other were also calculated. Age of onset adjusted for age at the time of treatment remained significantly related to net loss at 4 years ($r = -0.34$, $P < 0.05$) while age at treatment adjusted for age of onset did not.

Weight change patterns or subjects categorized by age of onset of obesity are shown in Fig. 3. Repeated measures analysis for age of onset indicated significant effects for time ($P < 0.0001$) and sex by time ($P < 0.001$). In men,

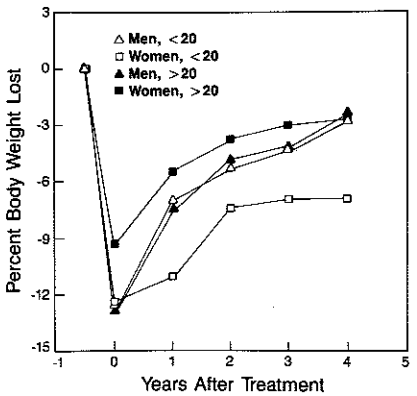

Fig. 3. *Average weight losses as a function of sex and age of obesity onset.* △, men <20; □, women <20; ▲, men >20; ■, women >20.

subjects obese before age 20 showed a nearly identical outcome to subjects becoming obese after age 20. In women, the younger onset subjects lost more weight initially and maintained that superiority throughout follow-up. For use of techniques, repeated measures ANOVA indicated significant time ($P < 0.0001$), technique ($P < 0.05$) and technique × sex ($P < 0.001$) effects. Subjects in the upper half of technique use had better outcome and regained at a somewhat slower rate. The technique group differences were larger in women than in men, with the high use group of women showing a degree of recovery at the fourth year of follow-up. Consistent with the correlational analyses, no impact of number of posttreatment diets was found.

Patterns of weight regain

We were particularly interested in examining our data for subsets of subjects with distinct patterns of weight change. Specifically, we wished to determine the frequency of continued loss, stable maintenance, yo-yo gain and loss, or other patterns distinct from the average pattern of monotonic regain. We initially examined the data by applying as the criterion for meaningful weight change a gain or loss of 2.5 percent of initial body weight (i.e. 5 lb or more in a 200 lb individual).

To our surprise, even this modest criterion gave little indication that fluctuations from the typical pattern of increasing relapse over time are common. As noted earlier, only 0.9 percent of the men and 5.3 percent of the women maintained their initial loss throughout the follow-up period. Only one person, a women, showed increased loss at each of the follow-ups. At the 4-year follow-up, 2.6 percent of men and 28.9 percent of women weighed the same or less than at the end of treatment. These figures indicate the greater variability in women's posttreatment weight changes. The relative infrequency of sustained recovery from relapse is apparent in the fact that 30.7 percent of men and 63.2 percent of women showed a meaningful loss at one or more of the follow-ups but only 16.7 percent of men and 36.8 percent of women regained half or more of their treatment weight loss and subsequently relost weight to at least 50 percent of their initial loss. Only 3.5 of men and 10.5 percent of women maintained such recovery for the last 2 or more years of follow-up. Finally, with regard to a 'yo-yo' phenomenon, 30.7 percent of men and 60.5 percent of women showed at least

one 2.5 percent gain and 2.5 percent loss during the 4 years of follow-up. However, only 10.5 percent of men and 7.9 percent of women showed a 3-year pattern of two significant gains interspaced with a loss or two losses separated by a gain.

In summary, for men and women respectively, 0.9 and 5.3 percent showed stable maintenance, 3.5 and 10.5 percent showed significant recovery from relapse, and 10.5 and 7.9 percent appeared to yo-yo. In men, approximately 70 percent showed a pattern of monotonic increase in weight regain over follow-up while 15.8 percent had a pattern of regain interrupted by a single weight loss. For women the comparable percents were 36.8 and 41.3.

Discussion

The overall findings of this study support previous discouraging reports about the long-term stability of weight losses produced by behavior therapy. Failure to maintain weight in our study participants is consistent with other controlled studies relying on measured rather than self-reported weights[26,27,32]. Similarly, in studies providing weight loss data for two or more follow-up periods, few subjects were at or below their posttreatment weights on each occasion[26,33]. The predominant outcome is typically some degree of weight regain at each visit.

Annual follow-up examinations on both men and women following successful weight loss treatment by behavior therapy show a nearly invariant pattern of weight regain. Weight regain curves were negatively accelerating over time, suggesting that they may reach an asymptote near or perhaps somewhat below baseline values. The discouraging aspect of this data is the observation that less than 3 percent of subjects maintained posttreatment weights throughout the 4 years of follow-up observation, while nearly 40 percent gained weight at least to baseline levels or above at some point during the follow-up. The bright side of this picture is that, substantial recidivism aside, there were measurable residual benefits for behavioral weight management programs 4 and 5 years beyond termination of initial treatment. For individual subjects, 18.5 percent maintained at least half of their losses throughout follow-up and 34 percent kept off at least one quarter. Evaluating our results is complicated by the lack of a standard comparison group. A proper 'control' group might show a downward or upward slope in weight change over time rather than the steady state (i.e. baseline weight) we typically compare our results to. Thus, our intervention resulted in no meaningful long-term effect if one assumes that the population will lose weight but quite good outcome if one assumes that weight gain is the norm.

The most intriguing aspect of the outcome data was the striking evidence for gender differences. Men and women in our sample were quite similar at baseline with respect to percent overweight, age, and age of onset. Moreover, in the follow-up period they did not differ significantly in reported use of dietary or behavioral methods. Nevertheless, there were clear differences in outcome. Compared to the men, women lost less weight in treatment but showed a consistently superior pattern of weight maintenance and greater resistance to returning to baseline weight. Importantly, hypothesized predictors for weight

regain also showed substantial differences by gender. Participation in formal weight programs prior to treatment was, as anticipated, negatively associated with degree of weight loss in both men and women. Surprisingly, however, in women prior program participation was associated with relatively good weight maintenance experience, whereas in men the opposite was true. There was also an gender difference with regard to age of onset. Men with early and late age of onset of obesity showed identical weight loss and regain patterns. However, women with onset before age 20 lost more weight and maintained the loss better than women with later age of onset.

These gender differences in weight loss and maintenance experience are probably related to differences in social expectations and environment. Women experience greater internal and external pressure to diet and lose weight than men due to our cultural milieu[34]. Thus, we would expect that the women in our sample would have made repeated efforts to lose weight and that duration of overweight and prior experience in weight loss programs would correlate with these efforts. Unfortunately our data are limited in regard to testing this idea. Better measures of the time course of actual weight management efforts over time are needed. The sex differences in our data suggest that generalizations about weight loss and maintenance experience derived from one gender cannot be easily translated to the other and that further thought might even be given to using different treatment approaches.

Our original thinking in pursuing the patterns of weight regain was at least in part to see what evidence we could find in weight regain curves for biologic versus social learning hypotheses about weight management variables. As would be expected our data are consistent with the notion that both sources of variability are relevant. On the one hand, the clear predominance in our data of a monotonic trend in individuals as well as in the group as a whole toward weight regain with time, and at rates considerably in excess of that associated with aging alone, would seem to implicate some biologic process. However, there certainly are data inconsistent with a purely physiologic model. For example, at least among men, the rate of regain was not related to the amount of the actual weight loss, and subjects showed little tendency to stabilize their weights at or near baseline values. In women there did not seem to be some findings to this effect. That is, those losing larger amounts of weight did regain more over the course of the 4 years of follow-up than those losing smaller amounts, and there was a greater tendency to reach an asymptote. Interestingly, however, the asymptote was 5 percent below baseline weight. In any event, it is difficult for the present investigators to conceive of the regaining phenomenon to occur solely on the basis of the strength of habit patterns. Surely, higher success rates would be possible and more variability in patterns would be observed without a strong biological underpinning.

The flip side of this argument, of course, are the exceptions to the biological rule. We did observe success stories (albeit few) in both sexes. We also observed fairly large numbers of instances in which individuals between any two years of follow-up did lose weight after having gained weight in previous years. The frequencies of these deviations was considerably higher in women than in men, which in itself speaks for the possibility of a large social component given that

no known biological forces favor better maintenance in women and some oppose it[35]. Moreover, the positive correlation between reported use of behavioral techniques and weight loss and maintenance speaks to this issue. Overall we are inclined to think that there is a powerful biological imperative involved in these weight regain phenomenon, but that under appropriate circumstances this imperative might be overridden. The means for doing so, however, clearly involve more clout than current behavioral methodologies.

Although the present results were not particularly encouraging, prospects for the future may be better. Recent work by Perri and his colleagues[35] employing multicomponent and long-lasting maintenance programs has begun to yield positive results. His suggestion of the need for even longer or perhaps on-going intervention is also in line with recent thoughts about obesity from a public health point of view[36,37]. Obesity has typically been treated as if it is an acute illness when it may more appropriately and perhaps profitably be viewed as a chronic condition much like cardiovascular disease or diabetes. Thus, efforts to treat obesity include efforts not only at the individual but also community and national levels. Hence, the work of Perri will hopefully be a single component of efforts which include such things as community intervention (e.g. lowering community fat consumption through education and attitude change) and policy shifts (e.g. increased production of lean meats or removal of salt and sugar from processed products). Finally, the development of such efforts will be aided by our increasing knowledge about the genetic[38], hedonic[39], and physiological[40] factors influencing weight and food intake.

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